Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE TAUGHT STUDENT HANDBOOK

YEAR 3 (FHEQ LEVEL 6)

ELECTRONIC AND ELECTRICAL ENGINEERING DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2023-24

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS

25 September 2023 – 15 December 2023

8 January 2024 – 22 March 2024

15 April 2024 – 07 June 2024

SEMESTER 1

25 September 2023 – 29 January 2024

SEMESTER 2

29 January 2024 – 07 June 2024

SUMMER

10 June 2024 – 20 September 2024

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

At Swansea University and in the Faculty of Science and Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone.

Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic, technical and administrative staff, administrators - I'm sure you will find many friendly helping hands ready to assist you. And make the most of living and working alongside your fellow students.

During your time with us, please learn, create, collaborate, and most of all – enjoy yourself!

Professor David Smith
Pro-Vice-Chancellor and Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Pro-Vice-Chancellor and Executive Dean	Professor David Smith
Director of Faculty Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Laura Roberts
School of Aerospace, Civil, Electrical, General and Mechanical Engineering	
Head of School	Professor Antonio Gil
School Education Lead	Professor Cris Arnold
Head of Electronic and Electrical Engineering	Professor Vincent Teng
Electronic and Electrical Engineering Programme Director	Dr Karin Ennser
Year Coordinators	Dr Zhongfu Zhou

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 8.30am-4pm.

The **Student Support Team** provides dedicated and professional support to all students in the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to other resources:

https://myuni.swansea.ac.uk/fse/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 23-24 handbooks to ensure that you have access to the most up-to-date versions.
We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/

Supporting Your Studies

- Centre for Academic Success
- Faculty of Science and Engineering- Student Support

Supporting Your Professional Development

As a third-year student studying *Electronic and Electrical Engineering* at Swansea University you are continuing a journey which we hope will end with Engineering Council registration as either an Incorporated Engineer (IEng) or Chartered Engineer (CEng).

Each of the Bachelor of Engineering (BEng) programmes covered by this handbook has been accredited by the Institution of Engineering and Technology (IET) on behalf of the Engineering Council for the purpose of fully meeting the academic requirement for registration as an Incorporated Engineer (IEng) and partially meeting the academic requirement for registration as a Chartered Engineer (CEng).

Each of the Integrated Masters (MEng) programmes covered by this handbook has been accredited by the Institution of Engineering and Technology (IET) on behalf of the Engineering Council for the purpose of fully meeting the academic requirement for registration as a Chartered Engineer (CEng).

What this means for you is that the learning outcomes of each year of your programme of study has been carefully designed to align with Version 3 of the Engineering Council's Accreditation of Higher Education Programmes (AHEP) which forms the educational foundation for the UK Standard for Professional Engineering Competence (UK-SPEC).

The knowledge and skills you will have demonstrated by completing your programme of study are defined by achieving a set of learning outcomes distributed across the following key areas of competence:

- Science and mathematics
- Engineering analysis
- Design and innovation
- The engineer and society
- Engineering practice

To find out more about Professional Registration and what the AHEP competences are, please refer to the Engineering Council's Student Guide to Professional Registration and the Accreditation of Higher Education Programmes collated learning outcomes

The IET – Your Professional Home for Life

As a student at Swansea University, you are privileged to be associated with one of the small groups of universities that have been selected to be Academic Partners of the IET. The most tangible benefit of this is that you can register as a student member of the IET at no cost to yourself for the duration of your study. And as a student member of the IET, you can take *full advantage* of the benefits that membership of the IET offers. These include an impressive range of services supporting *Networking*, *Professional*

Development, *Learning Resources* and *Membership Benefits*. A summary of these is shown on the Get more from your partnership page.

In addition, if you are taking part a Year in Industry next year, your experience can be converted into the Engineering Technician (EngTech) qualification. Please contact your IET Student Advisor for details.

If you are graduating this year, as an Academic Partner of the IET, the University can offer you access to the IET's Graduate Advantage Scheme: that is, we will pay for your first year of full Membership of the IET, and you can use the post-nominals MIET straight after graduation for no cost. This will be especially useful as you start to gain and evidence the UK-SPEC competences you will need to complete your IEng or CEng professional registration.

IET on Campus

IET On Campus is designed to support everyone in the Department of Electronic and Electrical Engineering with students at the heart of it. The IET gives you access to tailored practical, technical, and career-related resources and helps you to create links with industry and other universities, building a platform for you to demonstrate your skills and raise your profile. At Swansea, the local branch of IET on Campus is run by the Electrical & Electronic Engineering Society (EEESoc) and is supported by the IET South Wales Local Network.

For more information, please join EEESoc and access their social media channels.

IET Student Advisor

Dr Chris Jobling (MIET, CEng) is the *IET Student Advisor* for Swansea University. Please get in touch with him if you want to find out more about the AHEP and UKSPEC, the IET, IET student membership, IET Scholarships, Graduate Advantage, IET Communities, or opportunities to get involved with Wales Southwest Local Network as an IET young professional volunteer. He will be happy to help.

Other members of staff associated with the IET at Swansea include:

- Dr Timothy Davies (MIET, CEng)
- Dr Augustine Egwebe (MIET)
- Dr Karin Ennser (MIET, CEng)
- Prof Lijie Li (FIET)
- Mr David Moody (MIET)

UK Electronics Skills Foundation

Swansea University is an academic partner from the UK Electronics Skills Foundation. The partnership means that you can benefit from the UKESF scholarship scheme, competitions, awards, and internship programme, which connects the most capable Electronics undergraduates with leading companies in the sector.

UKESF offers opportunities for undergraduates to take advantage of an industry placement, develop their employability skills, generous financial support, and the opportunity to network with professionals in the Electronics sector. Dr Karin Ennser is the *UKESF Student Advisor* for Swansea University. Please contact her if you want to find out more.

Prizes

The following prizes are awarded at the end of the academic year:

- *Institution of Engineering and Technology Prize* – This prize is awarded annually by the IET. The prize will be awarded to the final year undergraduate student on an IET accredited course who, in the opinion of the Board of Examiners, has demonstrated outstanding merit. In the event of insufficient merit being shown the prize will not be awarded.
- *R. G. Isaacs Prize in Electronic and Electrical Engineering* – The prize will be awarded to the Part III student in Electrical and Electronic Engineering whose project is considered by the Board of Examiners to be of outstanding merit. In the event of no project of high quality the prize will not be awarded.
- *W. Renwick Prize* – is awarded annually to the Year 3 student whose project has a computing component and is considered by the Board of Examiners to be of outstanding merit. In the event of no project of high quality the prize will not be awarded.

Faculty prizes and progression awards

The Faculty of Science and Engineering awards graduation prizes to the best Electrical and Electronic Engineering student in each graduating year.

In addition, it awards prizes to the best student in each year and progression awards to students who achieve high averages in each year's programme of studies. These prizes are awarded at a special ceremony and dinner held each year.

Year 3 (FHEQ Level 6) 2023/24
Electronic and Electrical Engineering

BEng Electronic and Electrical Engineering[H602,H605]
BEng Electronic and Electrical Engineering with a Year Abroad[H603]
BEng Electronic and Electrical Engineering with a Year in Industry[H604]
MEng Electronic and Electrical Engineering[H606]
MEng Electronic and Electrical Engineering with a Year Abroad[H600]
MEng Electronic and Electrical Engineering with a Year in Industry[H601]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
EG-3082 **Embedded Systems** **10 Credits** **Dr A Ali** **CORE**	**EG-319** **Integrated Circuit Design** **10 Credits** **Prof K Kalna/Dr A Ali** **CORE**
EG-342 **Power Systems** **10 Credits** **Dr M Fazeli** **CORE**	**EG-341** **Microwave Circuits and Antennas** **10 Credits** **Prof A Mehta** **CORE**
EG-345 **Power Electronics** **10 Credits** **Dr Z Zhou** **CORE**	
EGA333 **Communications** **10 Credits** **Prof A Mehta** **CORE**	
EG-3080 **Engineering Management (Aero, EEE, Mech)** **10 Credits** **Prof JC Arnold/Prof MR Jennings/Dr EH Jewell/Mr JK Mcfadzean/Dr B Morgan** **CORE**	
EG-353 **Research Project** **30 Credits** **Dr AC Tappenden/Dr M Fazeli/Prof PJ Holliman** **CORE**	
Total 120 Credits	

Optional Modules

Choose exactly 10 credits

EG-355	Quantum Devices	Prof K Kalna	TB1	10 (CORE)
EGA366	Kinematics and Programming for Robot	Dr AA Fahmy Abdo	TB1	10 (CORE)

And

Choose exactly 10 credits

EG-351	Internet of Things: Principles and Practice	Dr JW Jones	TB2	10 (CORE)
EGA305	Nanoelectronics	Prof KS Teng	TB2	10 (CORE)

EG-3080 Engineering Management (Aero, EEE, Mech)

Credits: 10 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof JC Arnold, Prof MR Jennings, Dr EH Jewell, Mr JK Mcfadzean, Dr B Morgan

Format: Core Lectures: 16
Discipline specific lectures: 3
Support tutorials: 3

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Discipline-specific lectures will cover the first 3 weeks to introduce and explain the subject-specific project. Lectures in the core components will follow over the next 7 weeks.

Important - Careers Services Support lectures will take place in TB1 but formal assessment marks will be released in TB2. Please be aware that this is compulsory and will appear on the TB1 timetable.

Module Aims: The goal of this course is to provide the skills for professional engineers to meet the challenges of their future careers, whether they be in academia, industry, or as an entrepreneur. Irrespective of future careers engineers will be involved in projects, management and business organisations and an awareness of these issues is important for all team members. It should be recognized that the topics included in the course are not limited to scientists and engineers, they are useful for people in any careers. This course is not aimed at making you a certified project manager, but to provide the skills that will allow you to be a more effective project team member and also when you start to take on the role of project manager.

With respect to business management aspects, the course will cover the basic concept of entrepreneurship before breaking down the essential elements of a business plan. The course will give the more entrepreneurial students guidance about how to go about commercialising their ideas and the less entrepreneurial students an understanding of what makes some of their colleagues tick. The learn by example approach adopted for this module guides the student through the complexities of financial and human resource management and encourages students to develop their own business plans. Students will also be introduced to the subject area of ethics, liability and responsibilities within business. This module will also provide support on careers services with students creating CVs and Linked-In accounts.

Module Content: Pre-component
Careers Services Support - CV and Linked-In account

Section A. Programme Specific Component
There are three programme specific components:
All include lectures and then a subject-specific case study assignment covering the planning, scheduling and financial modelling of manufacturing processes in the relevant sector.
• Aerospace Engineering
• Mechanical Engineering
• Electrical and Electronic Engineering

Section B. Core Component
Financial aspects of Engineering Management
Introduction to financial planning, modelling and accounting, including consideration of fixed and variable costs, return on investments.
Entrepreneurship: Team building & Finance / Business Start-ups / The Business Planning process.

Project Management
Definition of a project and the stages within a project; project characteristics, project Stakeholders, what makes a successful project manager; triple constraint; standards and knowledge; management knowledge and skills
Project Life Cycle
Initiation, planning, execution and closure; Project charter; Objectives and Scope; Project planning; Scope; Requirements; Work breakdown structure; network diagram; resource planning and activity scheduling; Risk management.

Legal and ethical aspects of Engineering Management
Legal frameworks, liabilities, employee / employer aspects, the management of intellectual property. International standards and certifications.

Intended Learning Outcomes: Technical Outcomes
Upon completion of the module the student should be aware of and able to use:
- Some of the "tools" that assist in the efficient use of financial & human resources in manufacturing;
- Methods of writing a successful project plan
- Methods to assess the success of a project or business
- Approaches to ensure all projects and business activity is operating within a legal, ethical and responsible framework.

Accreditation Outcomes (AHEP)
D3p Work with information that may be incomplete or uncertain and quantify the effect of this on the design
ET5p Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues,
ET6p Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, and of risk assessment and risk management techniques.
EP5m Knowledge of relevant legal and contractual issues
EP6m Understanding of appropriate codes of practice and industry standards
EP7m Awareness of quality issues and their application to continuous improvement
EP11m Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader

Assessment:	Coursework 1 (2%)
	Coursework 2 (3%)
	Assignment 1 (30%)
	Examination 1 (65%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: The core component is assessed via a two-hour in-person examination in May/June.

The program specific components are assessed through one piece of coursework that is program specific (contributing 30% to the module grade).

There will also be a 5% component on Careers Support that will be completed in TB1 - 3% for completion of 5 specified units of the 'career development course' and 2% for CV (which will be assessed using 'VMOCK').

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 30% in the examination component, and a minimum of 40% overall for the module. If students do not meet the exam and module requirements they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 40%.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback:
Students will receive feedback on their coursework, together with a model answer, within three weeks of submission.
Feedback for the examination will be released via the exam feedback form.

Failure Redemption: A resit examination (2 hours) making up 100% of the resit mark.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Penalty for late submission of work: ZERO TOLERANCE.

The module is available to exchange students.

Notes and worked examples can be found on Canvas.

EG-3082 Embedded Systems

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-151; EG-152; EG-252

Co-requisite Modules:

Lecturer(s): Dr A Ali

Format: Lectures 20 hours
Laboratory work 30 hours
Directed private study 50 hours

Delivery Method: The module is delivered with 40% lectures and 60% laboratory work. All lectures will be recorded and made available on Canvas. The assessment consists of a combination of practical laboratory tasks (50%) and an on-campus invigilated examination (50%). Students will work in groups in the laboratory examination part, but each student will write and submit individual laboratory reports which will be marked individually.

Module Aims: The Embedded System course is designed to provide students with a comprehensive understanding of Raspberry Pi, and its programming capabilities using the Python programming language. Through a combination of theoretical concepts and hands-on laboratory experiments, students will gain the knowledge and skills necessary to develop and implement their own Raspberry Pi projects using Python.

Module Content: •Introduction to Embedded Systems
Introduction to Raspberry Pi and its applications
Setting up Raspberry Pi and installing Python, Visual
Studio Code and Thonny

•Interfacing with GPIO
Understanding General Purpose Input/Output (GPIO)
Controlling LEDs with switches
Reading Analog Voltages Using a Potentiometer
Controlling Dimmable LEDs with Potentiometers
LED blinking, button-controlled LEDs, sensor readings

•Interfacing various graphical user interfaces (GUIs) and Sensors and Controlling Actuators
Working with PWM (Pulse Width Modulation)
Temperature and Humidity Sensor
LCD Display
Collecting and analyzing sensor data
Interfacing OLED Display using I2C protocol
Drawing various shapes on the OLED Display
Servo Motor, distance sensors

Intended Learning Outcomes: At the end of the module, the students will be able to
• Design and implement a microcontroller-based embedded system
• Develop application-specific embedded systems and their interfacing with external devices

Assessment: Laboratory 1 (15%)
Laboratory report (15%)
Examination (50%)
Laboratory 2 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: The combination of all assessments weighs 100%. The laboratory progress is assessed by a laboratory experiment in the mid of the semester (15%) and a laboratory report in the mid of the semester (15%).
At the end of the semester, the students will be assessed by a laboratory experiment (20%) and on-campus invigilated examination 50%

This module is assessed by a combination of examination and continual assessment. In order for the continual assessment marks to count, you must achieve at least 30% in the exam component. If you achieve less than 30% in the exam, then the module mark will be just the exam mark.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Feedback for each coursework piece will be provided within 3 weeks according to University regulations.
Formal examination feedback will be provided in a standard format on the FSE Canvas HUB. Information provided will be the average mark, maximum and minimum marks, for the module as a whole.

Failure Redemption: If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on campus.
• NOT AVAILABLE TO Visiting and Exchange Students due to number restrictions.
• Laboratory classes or their online equivalent are compulsory. Students must have sufficient attendance at laboratory classes or their online equivalent in order to be allowed to be assessed for the module.
• The Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

EG-319 Integrated Circuit Design

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules: EG-143; EG-240; EG-242; EG-355

Co-requisite Modules:

Lecturer(s): Prof K Kalna, Dr A Ali

Format: Lectures 22 hours
Example classes 8 hours
Directed private study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: The module will be delivered by standard lectures (2 lectures per week) and all learning material will be available on Canvas.

Module Aims: To provide an overview of the BiCMOS and CMOS technologies and the concepts of designing analog and digital integrated circuits in the context of CMOS technology.

Module Content: • Introduction to Bipolar, MOS, BiCMOS and BCD technologies.
• Analogue CMOS Sub-circuits: MOS Switch, Active Resistor, Current Sources, Bandgap References.
• CMOS Operational Amplifiers: Design of CMOS Op Amps.
• Top-down digital circuit design: from VLSI architecture design to CMOS fabrication

This module develops a knowledge and understanding of:
• CMOS, BiCMOS and power IC technologies;
• MOSFET and BJT switch, active resistor;
• Fundamental building blocks of Analogue ICs (Common - Source/Drain/Gate amplifiers and current mirrors);
• Differential Amplifiers, CMOS Operational Amplifiers and Bandgap reference circuits.
• Digital IC design system and component aspects, design verification, VHDL and Verilog Code, signal integrity, clocking.

And develops an ability to:
• Apply large-signal circuit analysis and interpret the results.
• Analyse CMOS and bipolar analogue circuits by performing small-signal analysis.
• Understand top-down digital design approach focusing on CMOS technology.
• Understand the practical implications of different IC analysis methods.
• Design more complex circuits by combining fundamental IC building blocks.

Intended Learning Outcomes: After completing this module you should be able to:
• Describe CMOS technology;
• Analyse the operation of Analogue/Digital CMOS circuits;
• Apply some aspects of the Computer-Aided Analysis Programs in the design process of CMOS circuits.

AHEP3 Learning Outcomes:
SM4m Awareness of developing technologies related to own specialisation.
SM5m A comprehensive knowledge and understanding of mathematical and computational models relevant to the engineering discipline, and an appreciation of their limitations.
EA1m Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes.
D1m Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics.
ET2p Knowledge and understanding of the commercial, economic and social context of engineering processes
EP1p Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc)
EP7m Awareness of quality issues and their application to continuous improvement

Assessment: Examination 1 (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: End of term examination worth 100% of the module.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: For the examination the students will receive a generic form that tells the student what common mistakes were. It also lists the mean mark and the number of 1st class, 2:1 class, 2:2 class, 3rd class and fails achieved by the group. Individually the students can make appointments with the lecturer to reveive specific individual feedback on the assignment or examination if this is wanted/needed.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: Kaeslin, Hubert., Digital integrated circuit design : from VLSI architectures to CMOS fabrication / Hubert Kaeslin., Cambridge University Press,, 2008.ISBN: 9780521882675
Allen, Phillip E., Holberg, Douglas R., CMOS analog circuit design / Phillip E. Allen and Douglas R. Holberg., Oxford University Press, USA,, c2012..ISBN: 9780199765072
Gray, Paul R.,, Analysis and design of analog integrated circuits / Paul R. Gray ... [et al.]., Wiley,, 2010.ISBN: 9780470398777
Tony Chan. Carusone, David Johns 1958-; Kenneth W Martin (Kenneth William), 1952-; David Johns 1958-, Analog integrated circuit design / Tony Chan Carusone, David A. Johns, Kenneth W. Martin., John Wiley & Sons, 2012.ISBN: 9781118092330
Johns, David,, Martin, Kenneth W., Analog integrated circuit design / David Johns, Ken Martin., Wiley,, c1997..ISBN: 0471144487

Additional Notes: • AVAILABLE TO Visiting and Exchange students. Replaces module EG-354.
• Penalty for late submission of work: ZERO TOLERANCE.

EG-341 Microwave Circuits and Antennas

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules: EGA207

Co-requisite Modules:

Lecturer(s): Prof A Mehta

Format: Lectures 20 hours
Example classes 5 hours
Directed private study 75 hours

Delivery Method: 100% lecture based

Module Aims: The module develops the analysis and synthesis of distributed circuits and the principles of microwave antennas.

Module Content:

• Analysis of cascaded networks; the use of ABCD parameters and scattering parameters.
• Theory of the Smith Chart and its practical application to transmission line problems.
• Microwave circuit design, synthesis of microwave distributed filters, matching circuits and transformers.
• Circuit realisation in microstrip.
• Antenna theory - phased array and microwave antennas.

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:
• Apply a Smith Chart to solve problems associated with distributed circuits.
• Analyse a cascaded network of distributed components with ABCD- and S-parameters.
• Synthesise microwave distributed filters.
• Analyse the radiation patterns from microwave aperture and array antennas.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1p)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2p)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2p)
- Apply advanced problem-solving skills, technical knowledge and understanding, to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal (D4p)
- Ability to work with technical uncertainty (EP8p)

Assessment: Examination 1 (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: This module is assessed by means of a single 2-hour examination. The format of the exam is a choice of 3 questions from 4.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Feedback will be in a standard format on the College of Engineering Intranet. Information provided includes average mark, maximum and minimum marks, for the examination as a whole and for individual questions.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: David M. Pozar, Microwave engineering / David M. Pozar., Wiley, 2012.ISBN: 9780470631553
Kraus, John Daniel,, Fleisch, Daniel A., Electromagnetics : with applications / John D. Kraus, Daniel A. Fleisch ; with a chapter on "Electromagnetic effects in high speed digital systems" by Samuel H. Russ., WCB/McGraw-Hill,, c1999..ISBN: 9780071164290
David K. Cheng, Field and wave electromagnetics David K. Cheng., Pearson, 2013.ISBN: 9781292038940
Cheng, David K., Field and wave electromagnetics / David K. Cheng., Addison-Wesley,, 1989.ISBN: 0201528207

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

• AVAILABLE TO Visiting and Exchange students.
• PENALTY: zero tolerance for late submission

EG-342 Power Systems

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-241; EGA107

Co-requisite Modules:

Lecturer(s): Dr M Fazeli

Format: Lecture (class, examples, tutorial): 30 Hours. Private study: at least 70 hours

Delivery Method: Classroom sessions.
100% Examination.

Module Aims: This module aims to introduce the component of a Power Network and analyse their operation in both balanced and unbalanced conditions

Module Content: • Introduction: 3-phase systems, Electromagnetism
• Transmission lines
• Synchronous generators
• Per Unit Calculations
• Symmetrical component and fault calculations

Intended Learning Outcomes: Technical Outcomes
On successful completion of this module students will be expected, at threshold level, to be able to:
• Model and analyse different components of a power system including transmission lines, synchronous generators and transformers in different operating modes, which demonstrate the comprehensive understanding of power systems operation (assessed by exam).
• Utilise Per Unit calculation to analyse power systems for both 1-phase and 3-phase systems, which demonstrate understanding of mathematical methods necessary to analyse power systems (assessed by exam).
• Construct the operating chart of a synchronous generator and utilise it to calculate active and reactive powers, power factor, etc. for different operating points, which demonstrate a through understanding of current practice and its limitations (assessed by exam).
• Apply symmetrical components to analyse an unbalanced power system and calculate the fault current, which demonstrate the ability to apply appropriate engineering analysis for solving complex problems (assessed by exam).

Accreditation Outcomes (AHEP)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2p)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2p)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4p)

Assessment: Examination (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination in TB1 exam period.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Feedback will be in a standard format on the College of Engineering Intranet. Information provided includes average mark, maximum and minimum marks for the examination as a whole and for individual questions.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: Weedy, B. M. (Birron Mathew), Electric power systems / Birron M. Weedy [and others]., John Wiley & Sons, Ltd., 2012.ISBN: 9780470682685
Bergen, Arthur R; Vittal, Vijay, Power systems analysis / Arthur R. Bergen, Vijay Vittal., Prentice Hall, 2000.ISBN: 9780136919902

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

AVAILABLE TO visiting and exchange students provided they know the pre-requisites modules.
Zero Tolerance for late submission.

EG-345 Power Electronics

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-241

Co-requisite Modules:

Lecturer(s): Dr Z Zhou

Format: On demand online teaching: 16 hours
On demand online examples and coursework support support: 6 hours
Directed private study: 78 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Assessment: closed book in-person examination (80%) and continuous assessment (20%)

The examination is worth 80% of the module. Answer 4 questions. Each question answered will be worth 25%. The examination topics will be those presented directly in the lectures.

The continuous assessment is worth 20% of the module. This is based on an assignment related to the simulation and analysis of power electronics converter circuits.

Module Aims:
The module introduces circuit topologies and switching techniques for power electronics systems.

Module Content:
• AC/DC converters
• Single and three phase DC-AC converters
• Boost and Buck DC/DC converters
• AC-AC converters
• PWM switching strategies for real-time control of power electronics converters
• Semiconductor power device power losses and thermal analysis

Intended Learning Outcomes: Technical Outcomes
After completing this module students should be able to:
• Understand, analyse and design power converters for power electronics applications.
• Choose, apply and analyse switching techniques for real-time control of power electronics converter systems.
• Evaluate semiconductor power device power losses and thermal analysis.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1p)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2p)
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support study of their own engineering discipline (SM3p)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2p)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3p)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4p)

Assessment:	Examination (80%) Assignment 1 (20%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Examination (80%) and continuous assessment (20%)

The examination is worth 80% of the module, answer 4 questions. Each question answered will be worth 25%. The examination topics will be those presented directly in the lectures.

The continuous assessment is worth 20% of the module. This is based on an assignment related to the simulation and analysis of power electronics circuits.

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 30% in the examination component, and a minimum of 40% overall for the module. If students do not meet the exam and module requirements they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 40%.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: For the examination, the students will receive an examination feedback summary sheet giving details of the common mistakes that were identified from the assessed exam scripts. It also lists the maximum, minimum and means marks for each question and the number of students attempting it. Feedback specific to each question is additionally provided to aid the students.

For the continuous assessment, the students will receive feedback giving details of the common mistakes that were identified from the submitted coursework. Individually students can make an appointment with the lecturer to receive individual feedback on the assignment if this is required.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: Mohan, Ned., Undeland, Tore M., Robbins, William P., Power electronics : converters, applications, and design / Ned Mohan, Tore M. Undeland, William P. Robbins., Wiley,, c2003..ISBN: 0471226939
Rashid, M. HKumar, Narendra, Kulkarni, Ashish R. (Ashish Rajeshwar), Power electronics : devices, circuits and applications / Muhammad H. Rashid, Narendra Kumar, Ashish R. Kulkarni., Pearson, 2014.ISBN: 1292037105
Rashid, M. H., Power electronics : circuits, devices, and applications / Muhammad H. Rashid., Pearson/Prentice Hall,, c2004..ISBN: 0131228153
Rashid, Muhammad H. (Muhammad Harunur)Kumar, Narendra, Kulkarni, Ashish R. (Ashish Rajeshwar), Power electronics : devices, circuits and applications / Muhammad H. Rashid, Narendra Kumar and Ashish R. Kulkarni., Pearson, 2014.ISBN: 0273769081

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

• AVAILABLE TO visiting and exchange students.
• Penalty for late submission of work: ZERO TOLERANCE.

EG-351 Internet of Things: Principles and Practice

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules: EG-244

Co-requisite Modules:

Lecturer(s): Dr JW Jones

Format: Each week consists of 2 x 1 hour lectures and a 2 hour practical session in a PC Lab

Delivery Method: This module is delivered via lectures and practical laboratory sessions based on campus.
All lecture material will be available on Canvas prior to the lecture.
All lectures will be recorded and made available on Canvas.

Module Aims: This module explores the principles, protocols, and techniques related to communication using sockets and embedded devices. Students will develop a deep understanding of socket programming, network protocols, and their application in the context of embedded systems.

The module combines theoretical knowledge with hands-on experience, allowing students to design, implement, and troubleshoot communication systems using sockets.

Module Content: • Introduction
- o The Internet Protocol Suite
- o Introduction to Embedded Systems and Communication Protocols
- o Basic concepts of socket programming
- o Client-Server architecture

• Socket Programming Fundamentals
- o Establishing TCP and UDP client connections
- o Implementing TCP and UDP servers
- o Dealing with multiple, concurrent client connections

• Introduction to MicroPython and ESP-32
- o Installation and Operation
- o Programming, debugging and testing using an IDE

• Wireless Communication Protocols
- o Bluetooth, Wi-Fi, Mesh networks
- o Design considerations for wireless communication in embedded devices

• Fundamentals of communication security
- o Secure socket programming techniques
- o Encryption and authentication protocols

• Troubleshooting and Debugging Communication Issues
- o Common issues and challenges in communication
- o Debugging techniques and tools for communication problems

Intended Learning Outcomes: Upon successful completion of this module, students will be able to:
• Understand the fundamental concepts and principles of communication protocols in the context of embedded systems.
• Apply socket programming techniques to establish communication channels between devices and external systems.
• Analyse and evaluate different communication protocols commonly used in modern devices.
• Design and implement efficient and reliable communication systems.
• Demonstrate proficiency in troubleshooting and debugging communication issues.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2p)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2p)
- Understanding of, and the ability to apply, an integrated or systems approach to solving engineering problems (EA4p)
- Understand and evaluate business, customer and user needs, including considerations such as the wider engineering context, public perception and aesthetics (D1p)
- Plan and manage the design process, including cost drivers, and evaluate outcomes (D5p)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (ET2p)
- Understanding of different roles within an engineering team and the ability to exercise initiative and personal responsibility, which may be as a team member or leader (EP11m)

Assessment:	Coursework 1 (70%) Examination (30%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: This module is assessed by a combination of 2 components: continual assessment (70%) and a standard examination (30%).

The continual assessment component will comprise 3 programming assignments worth 10%, 20% and 40% respectively.
The examination component will test the theoretical components of the module.

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 40% in the third assignment and examination component, and a minimum of 40% overall for the module. If students do not meet the requirements, they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 40%.

Moderation approach to main assessment: Not applicable

Assessment Feedback: For the continual assessment, all students will receive their marks and feedback on their assignment within two weeks of the assignment deadline. This will be in the format of annotated copies of their source code within two weeks of the assignment deadline.

For the exam component, feedback will be in the standard format on Canvas. Information provided includes average marks, maximum and minimum marks for the exam as a whole and for individual questions.

Failure Redemption: Failure of the continuous assessment component will take the form of a supplementary programming assignment in the weeks prior to the supplementary exam period. This will form 100% of the continuous assessment component.

Failure of the exam component will take the form of a supplementary examination.

Reading List: Kurose, James F., author., Ross, Keith W., 1956- author., Computer networking : a top-down approach, Pearson, 2013.ISBN: 0273775634

Additional Notes: • AVAILABLE TO Visiting and Exchange students.

• The Faculty has a ZERO TOLERANCE penalty for late submission of all continuous assessment.

• All students must have the necessary Python programming experience.

EG-353 Research Project

Credits: 30 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AC Tappenden, Dr M Fazeli, Prof PJ Holliman

Format: Formal Lectures 16 hours;
Directed private study (incl. meetings with supervisors) 284 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Weekly briefings on all aspects of project work, risk assessment, planning, research methods, and ethics as it applies to engineering and research work.

English for academic purposes, writing up, referencing and presenting, the engineering institutions, continuing professional development.

These will be backed up by regular one-on-one meetings with a supervisor who will provide guidance and feedback on an ongoing basis.

Module Aims:
The module involves the application of scientific and engineering principles to the solution of a practical problem associated with engineering systems and processes.

The student will gain experience in working independently on a substantial, individually assigned task, using accepted planning procedures. It will require and develop self-organisation and the critical evaluation of options and results, as well as developing technical knowledge in the chosen topic.

Module Content:
A series of compulsory weekly briefings in Semester 1 will cover topics such as:

- Introduction to the module
- Health, Safety and Risk Assessment
- Project Planning
- Using the Library for Research
- Engineering and Research Ethics
- Academic Integrity
- Referencing

There will also be a series of sessions delivered as part of the Academic Success Programme in Semester 2 to help students with writing of their final paper and preparing for their viva.

The schedule for all taught sessions will be available on Canvas, all briefings will be recorded and also available on Canvas.

Intended Learning Outcomes:
Learning Outcomes are mapped to those required to partially satisfy the educational requirements for Engineering Council Registration as a Chartered Engineer as part of an Accredited BEng Honours Degree Standard (UK HEQF Level 6) as defined by the UK Standard for Professional Engineering Competence (UK-SPEC) and the Accreditation of Higher Education Programmes 3rd Edition (AHEP 3).

The AHEP Learning Outcomes are categorised under six headings:
• Science and mathematics (SM1b, SM2b, SM3b)
• Engineering analysis (EA1b, EA2, EA3b, EA4b)
• Design (D1, D2, D3b, D4, D5, D6)
• Economic, legal, social, ethical and environmental context (EL1, EL2, EL3, EL4. EL5, EL6)
• Engineering practice (P1, P2, P3, P4, P5, P6, P7, P8, P11)
• Additional general skills (G1, G2, G3, G4)

Precisely which subset of skills and learning outcomes will be covered in any particular project will vary, but all projects are expected to demonstrate the following Learning Outcomes at a threshold level:

• SM1b (all assessment components)
• SM3b (all assessment components)
• EA1b (all assessment components)
• EA2 (final paper and viva)
• EA3b (final paper and viva)
• D6 (final paper and viva)
• EL1 (ethics assessment)
• EL3 (project plan, project management)
• P1 (final paper and viva)
• P2 (final paper and viva)
• P4 (final paper and draft introduction)
• P8 (final paper, viva and project management)
• G1 (all assessment components)
• G2 (all assessment components)
• G3 (all assessment components)
• G4 (all assessment components)

Please see the Accreditation of Higher Education Programmes 3rd Edition for full descriptions of the above Learning Outcomes.

Assessment:	Project Planning Statement (5%) Project Management (0%) Progress Report (5%) Project Management (5%) Ethics Assessment (0%) Final Paper (50%) Oral Presentation (30%) Project Management (5%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: Credit bearing assessments:
- Project Planning Statement (5%)
- Progress Report (5%)
- Project Management 1 (5%)
- Final Paper (50%)
- Oral Presentation/Viva (30%)
- Project Management 2 (5%)

Non-credit bearing assessments:
- Ethics Assessment (pass/fail COMPULSORY assessment, must be passed to pass the module)
- Project Management check-in (0%)

Full assessment criteria will be on Canvas.

Moderation approach to main assessment: Universal Double Blind Marking of the whole cohort

Assessment Feedback:
Continuous feedback on progress will be delivered via meetings with supervisors.

Written feedback on assessment components will be delivered via the Feedback Studio.

There will be a formal opportunity to submit a Draft paper for preliminary review to provide detailed feedback to the student and provide the student with an opportunity to make modifications to the paper before final submission.

Failure Redemption: A resubmitting of the final paper and/or the viva presentation takes on the 100% resit option for EG-353

Reading List: R. J. Moffat author., Roy W. Henk author., Planning and executing credible experiments : a guidebook for engineering, science, industrial processes, agriculture, and business / Robert J. Moffat, Roy W. Henk., Hoboken, NJ : John Wiley & Sons, Inc., 2021.ISBN: 9781119532842
Engineering Council, The UK Standard for Professional Engineering Competence.
James D. Lester Jr., 1959- author., James D. Lester Sr., 1935-2006, author., Writing research papers : a complete guide / Jim D. Lester, James D. Lester, Harlow : Pearson Education Limited, 2014.ISBN: 9781292054117
Barrass, Robert., Scientists must write : a guide to better writing for scientists, engineers and students / Robert Barrass., Routledge,, 2002.ISBN: 9780415269964
How to Write a Paper, Engineering Department, University of Cambridge, 2005.
Alasdair Montgomery, Giles Lloyd-Brown, Allison Jones, Philippa Price, Library Support for Engineers. Avoiding Plagiarism (Cardiff University).
Engineering Council, Accreditation of Higher Education Programmes.
Pears, Richard, author., Shields, Graham J., author., Cite them right : the essential referencing guide, Bloomsbury Academic, 2022 - 2022.ISBN: 9781350933446
Jean-Luc. Lebrun, Scientific writing 2.0 a reader and writer's guide / Jean-Luc Lebrun., World Scientific, 2011.ISBN: 1283433826
Gastel, Barbara, author., Day, Robert A., 1924-2021, author., How to write and publish a scientific paper, Greenwood, 2022.ISBN: 9781440878848
Martha Davis 1935-, Kaaron J Davis; Marion M Dunagan, Scientific papers and presentations / Martha Davis, Kaaron J. Davis and Marion M. Dunagan., Amsterdam : Elsevier/AP, 2012.ISBN: 9780123847270
How to write a Paper in Scientific Journal Style and Format.
McGraw-Hill Companies., AccessEngineering., Columbus, OH : McGraw-Hill Global Education Holdings, LLC, 2009.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Only available to students following an Engineering Degree Programme.

The nature of the research project varies from one student to another. Projects may involve design, theoretical, experimental or computational studies.

The academic staff of the Faculty of Science and Engineering produce a list of project descriptors and students are given a chance to select a project over the summer before the start of the academic year. Alternatively students are offered the opportunity to define the topic of their own research project.

Students must attend all relevant weekly briefings, a detailed schedule of which will be available on Canvas.

Each student will be allocated a supervisor and it is recommended that students meet their supervisors at least once a fortnight to discuss progress.

There are a number of compulsory submissions (a project plan; an ethics assessment; a draft introduction; a progress report; a 10-page research paper; evidence of project management and a viva examination). Precise assessment criteria, deadlines, submission formats and instructions will be disseminated via Canvas.

The Faculty of Science and Engineering ZERO TOLERANCE penalty policy for late submission of coursework and continuous assessment will apply to all assessment elements apart from the final paper submission and viva.

Any late submissions on the final paper (not covered by extenuating circumstances) will be capped at 40%.

If a student fails to attend their scheduled Viva (not covered by extenuating circumstances) rescheduling may be permitted but both elements (presentation and defense) will be capped at 40%.

EG-355 Quantum Devices

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-142; EG-242

Co-requisite Modules:

Lecturer(s): Prof K Kalna

Format: Lectures & Example classes 22 hours
With Silvaco Software at PCs in the EEE Lab 360 hours
On Campus Labs with Silvaco Software at PCs 2 hours weekly
Directed private study 74 hours
Contact Hours will be delivered through activities on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: This module will be taught on the campus and will employ the Canvas Digital Learning Platform for self-directed online activity. The laboratory work will be on the campus.
This module will consist of lectures, which concentrate on a theory, and example classes, which concentrate on applying the theory to solve examples.
Assessment: Report from Device Modelling 20%, Exam - 80%.
Assessment by an individual report from the device modelling will consist of a small group of 2 students which will work together in the EEE Lab on the modelling of the semiconductor device.

Module Aims: To introduce state-of-the-art semiconductor devices like fin field effect transistors (FinFETs), metal-oxide-semiconductor field effect transistors (MOSFETs), high-electron mobility transistors (HEMTs), quantum well light emitting diodes (LEDs) & lasers, and resonant tunnelling diodes (RTDs). To evaluate the performance and design of state-of-the-art nanoscale semiconductor devices based on quantum-mechanical confinement.

Module Content: • A short advanced theory of the p-n junction as a basic building block of every semiconductor device.
• Metal-semiconductor interface as an essential structure to control semiconductor devices: Schottky/Ohmic contact & Bardeen theory of contacts.
• Introduction to Quantum, Schrödinger's equation, the concept of the wave vector, k-space, confinement and tunnelling.
• Application to the quantum well, optical confinement, laser devices, high electron mobility transistor (HEMT), metal oxide semiconductor (MOS) structure, metal oxide semiconductor field-effect transistor (MOSFET), a ballistic model for nano-MOSFET, deep nanoscale fin field effect transistor (FinFET), resonant tunnelling diode, and quantum cascade laser.
• High-electron mobility transistor for RF applications.
• Advanced device design (need to include quantum effects).

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:
• Understand basic principles of the operation of semiconductor devices;
• Analyse the suitability of semiconductor materials for device fabrication;
• Explain the importance of bulk and interface properties in device operation;
• Evaluate the state of the art industrial and research techniques to characterise materials and devices;
• Design simple quantum structures to produce laser diodes, high speed and digital transistors;
• Discuss the need for miniaturisation and evaluate its effect on device characteristics;
• Analyse the current concepts associated with future devices based on nanotechnology.

Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1p)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2p)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2p)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3p)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (EP1p)
-Understanding of the need for a high level of professional and ethical conduct inengineering and a knowledge of professional codes of conduct (ET1p)

Assessment:	Examination 1 (80%)
	Class Test 1 - Coursework (20%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description:
Assessment: An individual report from device simulations using Silvaco TCAD software. A small group of 2 students will work together on the modelling of a semiconductor device with a deadline set in the module schedule on Canvas (20%). Each group member will have to identify in the report his/her contribution to the common work.

Exam - in-person January 80%

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 30% in the examination component, and a minimum of 40% overall for the module. If students do not meet the exam and module requirements they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 40%.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Feedback will be available on a Canvas for the assessment project, during a specific lecture session, and in a standard format on the College of Engineering intranet. Information provided includes extensive comments on your assessment report, then average, maximum and minimum marks for the examination as a whole and for individual questions. The exam script will also contain comments on the particular mark which can be read after asking to see the exam answer sheet. There is also very important additional feedback given during the exercise classes.

Failure Redemption: Year 3 BEng: BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng: MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: Streetman, Ben., Solid State Electronic Devices, Pearson Education Limited, 2015.ISBN: 9781292060767
Streetman, Ben G. author., Banerjee, Sanjay, author., Solid state electronic devices., Pearson, 2016.ISBN: 9781292060552
Streetman, Ben G., Banerjee, Sanjay., Solid state electronic devices / Ben G Streetman and Sanjay Kumar Banerjee., Pearson Education International,, c2006..ISBN: 9780131497269
Yang, Edward S., Microelectronic devices / Edward S. Yang., McGraw-Hill,, 1988.ISBN: 0070722382
Sze, S. M., 1936- author., Li, Yiming (Professor of electrical engineering) author.; Ng, Kwok Kwok, 1952- author.; Sze, S. M., 1936-, Physics of semiconductor devices., Wiley, 2021.ISBN: 9781119429111
Sze, S. M., 1936-, Ng, Kwok Kwok, 1952-, Physics of semiconductor devices, Wiley-Interscience, 2007.ISBN: 9780470068304
Pierret, Robert F., Semiconductor fundamentals / Robert F. Pierret., Addison Wesley Publishing Company,, 1988.
M. J. Cooke, Semiconductor devices / M.J. Cooke., Prentice Hall, 1990.ISBN: 9780138062170
M. J. Cooke, Semiconductor Devices.

Additional Notes: Delivery of both teaching and assessment will be on-campus.
• AVAILABLE TO visiting and exchange students.
• Penalty for late submission of work: ZERO TOLERANCE.
• Assessment: An individual report from Device Modelling using Silvaco Atlas TCAD commercial tool. A small group of 2 students will work together on the modelling of a semiconductor device with a deadline at the end of October (20%). Each group member will have to identify in the individual report his/her contribution to the common work.
• Exam - January
• All the assessment submissions will be made via the submission tool provided by Canvas.

EGA305 Nanoelectronics

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules: EG-242

Co-requisite Modules:

Lecturer(s): Prof KS Teng

Format: Lectures 20 hours
Directed private study 80 hours

Delivery Method: Lecture and end of semester examination.

Module Aims: Nanoelectronics will soon succeed today's microelectronics technology and revolutionise the electronics industry. This cutting edge technology has major applications in both information and healthcare technologies, hence improving our quality of life. This module introduces the fundamental principle of nanoelectronics and its applications.

Module Content:
• Introduction on nanotechnology.
• Limitation in scaling down existing CMOS technology.
• Physical and electronic properties of low-dimensional nanoscale electronic materials.
• Characterisation on the nanoscale.
• Top-down and bottom-up nanofabrication techniques.
• Nanoelectronic devices, such as carbon nanotube devices and single-electron transistors.
• Molecular electronics.

Intended Learning Outcomes: Accreditation Outcomes (AHEP)
- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1p)
- Awareness of developing technologies related to own specialism (SM4m)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2p)
- Knowledge and understanding of the commercial, economic and social context of engineering processes (ET2p)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (EP1p)
- Knowledge of characteristics of particular materials, equipment, processes, or products (EP2p)

Assessment: Examination 1 (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: 100% Examination

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Students receive feedback from formal examination through College's Community Page.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: Poole, Charles P., Owens, Frank J., Introduction to nanotechnology / Charles P. Poole, Jr., Frank J. Owens., J. Wiley,, c2003..ISBN: 9780471079354
Kelsall, Robert W.; Hamley, Ian W.; Geoghegan, Mark., Nanoscale science and technology, John Wiley, 2005.ISBN: 9780470850862
Dragoman, Mircea,, Dragoman, Daniela,, Nanoelectronics : principles and devices / Mircea Dragoman, Daniela Dragoman., Artech House,, c2009..ISBN: 9781596933682

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

• Notes and example sheets for the module are available on Canvas.

EGA333 Communications

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof A Mehta

Format: 2 Lecture per week
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Assessment: Examination

Module Aims: Enabling students to secure strong understanding of the current communication technologies, both from the theoretical and experimental point of views.

Module Content:

• Fundamentals of analogue and digital signals.
• Concept of modulation in amplitude, phase and frequency.
• Modulation and demodulation of analogue signals: AM, DSB, SSB and FM.
• Baseband digital signals: sampling quantization, spectra, aliasing.
• Modulation and demodulation of digital signals: ASK, FSK, QPSK, QAM.
• Analysis of the above rf signals in both time and frequency domains.
• Access technologies: CDMA, OFDM.
• Introduction to Modern Systems: GSM, CDMA, WIFI, WIMAX, 3G, 4G, MIMOs, UWB, GPS, RFIDs.

Intended Learning Outcomes: Technical Outcomes
After completing this module you should be able to:

• Relate wavelength and frequency, and explain the usage of different parts of the radio spectrum.
• Compare the analysis in time and frequency of various amplitude modulations.
• Understand the parameters that control the bandwidth of FM signals.
• Understand sampling theory associated with baseband digital signals: quantisation error, aliasing etc.
• Determine the spectra of digital baseband and rf signals and the effects of encoding.
• Use of SNR and Bandwidth knowledge and calculations to design efficient practical communication links for satellite and wifi networks.

Also have an understanding of:

• Transmission and reception of digital signals.
• Cellular voice system and data (internet) systems.
• The application of communication technology for various modern applications, e.g. RFIDs and MIMOs.

Accreditation Outcomes (AHEP)

- Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of relevant historical, current and future developments and technologies (SM1p)
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2p)
- Understanding of engineering principles and the ability to apply them to analyse key engineering processes (EA1p)
- Apply advanced problem-solving skills, technical knowledge and understanding, to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal (D4p)
- Understanding of contexts in which engineering knowledge can be applied (eg operations and management, application and development of technology, etc) (EP1p)
- Ability to apply relevant practical and laboratory skills (EP3p)

Assessment:	Examination 1 (100%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: The module is assessed by a 2 hour examination - answer 3 out of 4 questions.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Feedback will be in a standard format on the College of Engineering intranet. Information provided includes average marks, maximum and minimum marks for the exam as a whole and for individual questions.

Students are also encouraged to meet the academic for any specific feedback, if required.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: David M. Pozar, Microwave engineering / David M. Pozar., Wiley, 2012.ISBN: 9780470631553
Constantine A. Balanis author., Antenna theory : analysis and design / Constantine A. Balanis., Hoboken, New Jersey : Wiley, 2016.ISBN: 1523110058
Constantine A. Balanis 1938-, Antenna theory : analysis and design / Constantine A. Balanis., Wiley-Interscience, 2005.ISBN: 9780471667827
David M. Pozar, Microwave and RF design of wireless systems / David Pozar., Wiley, 2000.ISBN: 9780471322825

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.
• AVAILABLE TO visiting and exchange students
• Notes, worked examples and past papers for this module can be found on Canvas.

EGA366 Kinematics and Programming for Robot

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AA Fahmy Abdo

Format:
10h lectures
16h computer labs (8h tutorial, 8h supervised)
1h concept testing in Robot Lab (4 students per group)
16h self-guided programming in computer lab
57h self-directed study

Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Lectures; Tutorials; Supervised project in computer lab/robot lab; Self-guided projects in computer lab/robot lab .

Module Aims: This module first examines the historical development of robotics, both technical and sociological. And then introduces various application of robot technologies focusing on manufacturing, both existing and potential are examined. The core of the module lies in the studies of robot kinematics including trajectory planning and programming. As part of this, industrial standard robot models are analysed and practically experienced through simulation toolkit and commercial software.

Module Content: 1. History and development of robotics;
2. Overview of robot industry and applications;
3. Robot actuators, sensors and end effectors.
4. Repeatability and accuracy of robot manipulation;
5. The kinematic model, including Rotation Matrix, Homogeneous Transformation matrix and Euler Angles;
6. Calculation of forwarding and Inverse kinematics;
7. Differential kinematics including Linear and angular velocities and accelerations of manipulator links as well as Jacobian matrix;
8. Trajectory planning including both polynomial and LSPB methods;
9. Robot controllers (open/closed loop);
10. Robot programming and simulation, then the module mark will be just the exam mark.

Intended Learning Outcomes:
Technical Outcomes
At the end of the module the student will be expected to be able to:
- Discuss the historical development of robotics from technical, philosophical and sociological viewpoints.
- Identify, classify and construct kinematic models for a wide range of robots.
- Calculate forward and inverse kinematics and plan motion trajectories.
- Skillfully use simulation tool kits and commercial software to construct robot models and to plan its motion.

Accreditation Outcomes (AHEP)
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques (EA2)
- Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action (EA3b)

Assessment:
Coursework 1 (30%)
Examination (50%)
Coursework 2 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: 2 hours written examination covering (1) - (5): 50%
Coursework based on 2 projects covering (3) and (6): 50%

(1) Robotic history and development: the history from ancient automated machine to modern industrial and service robot; identification of the application fields and associated industry.
(2) Robotic actuators, sensors and end effectors: electromagnetic, pneumatic, and memory alloy types of actuators; both passive and active types of sensors typically equipped on a robot; the design of the robot end-effector; the advantage and disadvantage of each type.
(3) Robot kinematics: homogeneous transformation; Denavit-Hartenburg (DH) model which enable standard robot modelling.
(4) Differential kinematics: the mapping between velocities in joint space and in Cartesian space, i.e., Jacobian matrix.
(5) Trajectory planning: polynomial approach, e.g., quintic polynomial trajectory, and linear segment with parabolic bend (LSPB) approach
(6) Robot programming and simulation: introduce 3D simulation of the robot's motion based on the DH models, as well as motion planning and task simulation based on the commercial software. Teach the means to transfer codes from a simulator to a physical robot.

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 30% in the examination component, and a minimum of 40% overall for the module. If students do not meet the exam and module requirements they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 40%.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: General feedback for written exam;
Individual feedback for projects based coursework.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Reading List: Corke, Peter I., Robotics, vision and control : fundamental algorithms in MATLAB / Peter Corke., Springer, 2013.ISBN: 9783642201431
Sciavicco, L. (Lorenzo); Siciliano, Bruno, Modelling and control of robot manipulators / Lorenzo Sciavicco and Bruno Siciliano., Springer, 2000.ISBN: 9781852332211
Zhijun. Li, Chenguang Yang; Liping Fan, Advanced control of wheeled inverted pendulum systems / Zhijun Li, Chenguang Yang, Liping Fan., Springer, 2012.ISBN: 9781447129622

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.